

Hearing Conservation in the U.S. Army

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CONTINUED exposure to high-intensity noise can result in hearing loss, thus affecting the health, efficiency, and well-being of persons exposed. This loss may be temporary, disappearing after a period of nonexposure, or it may be permanent, creating an irreversible impairment of a person's ability to hear certain sounds. This impairment is caused by injury within the cochlea and initially affects the hearing of sounds with frequencies between 4,000 and 6,000 hertz.

Extensive damage to the ability to perceive high-frequency sounds may be sustained before loss of hearing in the important range of speech (500–2,000 hertz). Continued exposure may cause a progressive hearing loss in the speech frequencies, severely handicapping the victim.

The need for a comprehensive hearing conservation program depends on the potential noise hazard. Many yardsticks are available to preventive medicine and safety personnel for making this determination.

The best subjective indication comes from the person who complains that conditions are annoying or unsatisfactory. These conditions take many forms, but the most prevalent include dif-

ficulty in communicating by speech while in a noisy area, a ringing sensation in the ears (tinnitus), reduced auditory sensitivity (temporary threshold shift), and general fatigue and irritability.

This type of inherent warning system sometimes fails when people have developed, through years of being exposed to a noisy environment, acceptance of these conditions. These persons, singly and as a group, fail to recognize, through design or ignorance, the deleterious effects that high-intensity noise may have on their hearing. Such persons include career infantry and artillery soldiers, some older aircraft pilots, and certain workers such as carpenters, machinists, and boilerroom operators. It is their situations which require maximum emphasis on health education, supervision, and discipline of personnel.

Measurement of Noise

After unsatisfactory conditions have become apparent, it becomes necessary for medical, safety, and engineering personnel to determine objectively the presence and extent of the potential hazard. This is usually done electroacoustically with a sound level meter or an octave band analyzer, or both. Thus, the first essential of a hearing conservation program is initiated: the determination of a potentially hazardous area by noise measurement and analysis.

Noise measurements are made at the position usually occupied by the exposed person's head. A calibrated sound level meter conforming to the American Standard for General-Purpose Sound Level Meters is used to measure the

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sound pressure level in decibels relative to a known reference (0.0002 microbar). It is important during these measurements to have an environmental situation similar to usual operating conditions and to make as many measurements as necessary to give adequate consideration to the entire exposed area. Measurements are also made when the equipment is running at maximum output if operating conditions vary.

A properly calibrated sound level meter provides a single-number rating for noise relative to one or more of three weighting networks designated A, B, and C. These three weighting networks have frequency response characteristics that selectively discriminate against low and high frequencies in accordance with certain equal-loudness contours. Current Army regulations consider a noise level to be potentially hazardous when it exceeds 90 decibels overall level ("flat" response or C scale) for steady-state noise and 140 decibels for impulse noise.

Spectral analysis of a given exposure is necessary when there is a need to know the precise distribution of acoustical energy. An octave band analyzer is used for this type of assessment.

It then becomes necessary either to eliminate the noxious element or to protect the person who is exposed. This leads into the next two essentials of the program: engineering control and hearing protection.

Engineering control measures are not discussed in detail in this paper because of the complexities involved. It is certainly the aim of a comprehensive hearing conservation program to eliminate or reduce to the maximum extent possible potentially hazardous noise.

Hearing Protection

Personal hearing protection begins with determining the type of device desired. Three types of hearing protective devices are in the Army's inventory: the insert type earplug, the circumaural type or ear muff, and the helmet which incorporates communication equipment within a crash-protective shell. Ordinarily, if electronic communication systems are not involved, earplugs and ear muffs are used, either alone or in combination.

The Army does not have specified attenua-

tion requirements for earplugs. However, typical attenuation values for the Army's current inventory of earplugs are shown in the following table:

<i>Frequency in hertz</i>	<i>Attenuation in decibels</i>
125-----	25
250-----	25
500-----	25
1,000-----	25
2,000-----	30
3,000-----	35
4,000-----	35
6,000-----	35
8,000-----	35

A Department of Defense standard specifies the following attenuation requirements for circumaural protectors.

<i>Frequency in hertz</i>	<i>Attenuation in decibels</i>
125-----	15 or more
250-----	20 or more
500-----	35 or more
1,000-----	35 or more
2,000-----	35 or more
3,000-----	35 or more
4,000-----	35 or more
6,000-----	30 or more
8,000-----	30 or more

The selection of a hearing protective device depends on user acceptance, type of job being performed, efficiency of attenuation of the device, and cost. Of significant importance is the availability of trained personnel to fit earplugs. Medical personnel working in preventive medicine, audiology, or ear, nose, and throat clinics usually do the fitting.

The Army presently has three types of earplugs available for distribution. These are the V-51R, single-flange type, available in five sizes; the triple-flange type available in two sizes; and the disposable, wax-impregnated, cotton type. One set of the preformed variety is issued to each soldier when he enters the service and becomes his personal property. He is able to replace the earplugs readily if he loses those initially issued.

Many commanders require that these devices be attached to a portion of the soldier's outer clothing by means of the standard earplug carrying case. Instructors and permanent cadre are then able to determine quickly whether each soldier has a set of earplugs in his possession before any training involving exposure to

potentially hazardous noise. Earplugs and ear-plug carrying cases are procured through medical supply channels.

Ear muffs are being used extensively by the Army in areas with extremely high levels of noise. These areas usually include aircraft and armor maintenance shops and training areas in which there is prolonged exposure to firearms.

Audiometric Evaluation

The next essential of a hearing conservation program is measurement of hearing, or audiometry. A number of conditions must be satisfied before a valid audiometric testing program is in effect. Basically, these conditions include adequate instrumentation for testing and calibration, a quiet testing environment, properly trained operative and supervisory personnel, standardized evaluative methodology, and approved recordkeeping.

Both self-recording (automatic) and manually operated audiometers are used for determining audiometric evaluations. Audiometer calibration is handled by a special calibration team from either Atlanta Army Depot, Atlanta, Ga., or Sharpe Army Depot, Lathrop, Calif. The Atlanta depot services equipment from installations east of the Mississippi River, and the Sharpe depot services equipment from installations west of the Mississippi. All audiometers are checked on location at 6-month intervals by medical maintenance teams from one of the depots. Any deviation from the recognized standard reference threshold level is corrected at the installation by these visiting teams. Major repair and re-calibration of diagnostic audiometers are accomplished by returning the instrument to the depot.

Most audiometric testing environments consist of prefabricated, single-man, audiometric testing booths. These booths meet or exceed current standards established for audiometric testing environments by the American National Standards Institute.

All personnel performing audiometric evaluations must have received training equivalent to that specified by the Inter-Society Committee on Industrial Hearing Measurements composed of representatives from the Industrial Medical Association, American Industrial Hygiene Association, American Speech and

Hearing Association, and American Association of Industrial Nurses. Enlisted personnel assigned to work as audiometric technicians receive 3 weeks of classroom instruction at the Medical Field Service School, Brooke Army Medical Center, Fort Sam Houston, Tex., and 9 weeks' on-the-job training in an ear, nose, and throat clinic at an Army hospital. All work during and after training is supervised by otolaryngologists, preventive medicine officers, or audiologists.

For additional training, a military hearing conservation course is presented annually at the Army Environmental Hygiene Agency for officers and civilian physicians and nurses employed by the Army. This 2½-day program provides information and practical application of all essential elements of a hearing conservation program.

Audiometric evaluations are conducted for all military and civilian personnel as part of their physical examination when they enter the service and upon termination of service. In addition, audiometric evaluations are provided for persons assigned to work in a noisy environment where, depending on noise levels, they may be required to wear a hearing protective device. Threshold measurement by air conduction is required at audiometric test frequencies of 500, 1,000, 2,000, 3,000, 4,000, and 6,000 hertz. The person to be tested must spend at least 16 hours in an occupationally noise-free environment before audiometric testing is performed. Audiograms become a permanent part of the person's medical records and are used as a reference to compare changes in auditory sensitivity occurring at a later date.

Persons whose audiometric findings average 30 decibels or more at 500, 1,000, or 2,000 hertz and 55 decibels at 4,000 hertz in both ears or 25 decibels at 500, 1,000, or 2,000 hertz and 35 decibels at 4,000 hertz in their better ear on the third consecutive day of testing are referred to the nearest ear, nose, and throat clinic for differential diagnosis and medical treatment of the hearing disorder. If the clinical evaluation indicates a disorder in the inner ear, the person is restricted from habitual or frequent exposure to loud noises or firing of weapons.

Periodic audiometric testing of personnel already working in high noise areas is done at

the beginning of the workday from 60 to 90 days after job placement unless an earlier test is indicated by complaints of ringing in the ears or reduced auditory sensitivity. If the hearing level of the first periodic test does not differ from the reference audiogram by more than 10 decibels at any frequency, subsequent testing is done annually.

A change in threshold of 15 decibels or more at any frequency requires additional testing on 2 consecutive days. If a clinical evaluation continues to indicate inner ear involvement, the person is relieved of all duties involving steady-state noise exposure in excess of 90 decibels and all weapons firing for a minimum of 7 days. He is retested at that time. If the 7-day test is within 10 decibels of the reference audiogram, the person's hearing protective device is refitted and he is returned to duty. If the 7-day test reveals a permanent hearing loss, the person is removed from duties involving high exposure.

Health Education

Health education is the most essential element of the Army's hearing conservation program. Personnel who will be exposed to noise are informed of the nature of this hazard and are taught how to avoid harmful effects through the proper use and care of their protective equipment. This instruction is integrated with continuing on-the-job supervision.

Primary responsibility for educational processes rests with the preventive medicine officer,

but the best results are achieved with the interested cooperation and support of commanders and unit supervisors. Audiologists and safety personnel assist in implementing the overall program.

Areas designated as potentially noise-hazardous are identified with safety color code markings and signs. Signs measuring 10 inches in height and 14 inches in width are made at local installation training aids or sign shops for distribution as required. These signs have a yellow background covering the face of the sign; the word CAUTION appears in yellow letters on a black rectangular panel. An example of wording and design is shown in the figure.

Films concerning noise and conservation of hearing are available for short-term loan through local audiovisual communication centers. These films are listed and described in the "Film Reference Guide for Medicine and Allied Sciences" published annually by the Federal Advisory Council on Medical Training Aids. Additional films available through commercial sources may be rented or purchased depending upon the specific needs of an installation.

Conclusion and Summary

Hearing conservation is not new to the Army; it has been an integral part of the preventive medicine program for more than 15 years. What is new is a revitalization of existing programs brought about by increased awareness of com-



Sign warning of hazardous noise

manders and the soldier—an understanding that noise-induced hearing loss can be prevented through the proper implementation of five essential elements: noise measurement and analysis, engineering control, hearing protection, audiometry, and health education.

Continued exposure to high-intensity noise can result in hearing loss. A comprehensive hearing conservation program can prevent many of these impairments.

The Hearing Conservation Program in the Army is divided into the following five elements.

1. Identification of noise hazards by measuring sound levels in potentially noise-hazardous areas.

2. Medical surveillance including preplacement and periodic audiometric evaluation of workers exposed to potential noise hazards.

3. Hearing protection of persons exposed to hazardous noise by fitting them with personal protective devices, such as circumaural protectors (ear muffs) and earplugs. If they are properly fitted, both devices can provide adequate protection to the individual user.

4. Health education is the most difficult aspect of the program. Continued use of protective devices by the individual worker and continued interest of supervisory personnel can be achieved only through a continuing educational program about noise hazards and hearing conservation.

5. Engineering control is very costly and complex, especially if applied to existing industrial equipment and weapons. We feel that engineering modifications to eliminate noise should be made during the research and development stage of equipment to avoid the complexity and high cost of modification after the equipment is in mass production.

With the general awareness of environmental pollution, the Army has shown considerable interest in noise hazards and hearing protection. However, the success of the existing hearing conservation program requires a total commitment and genuine interest of everyone in the entire system.

Tearsheet Requests

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Division of Alcohol Abuse and Alcoholism, NIMH

A Division of Alcohol Abuse and Alcoholism has been formed in the National Institute of Mental Health, a component of the Health Services and Mental Health Administration. The objective of the new division is to eradicate alcohol abuse and alcoholism in the United States.

Fiscal year 1970 marked the first time that special funds were made available to establish comprehensive community treatment and rehabilitation services for alcoholics, with \$3,175,000 appropriated. The President's budget request for fiscal year 1971 is \$6 million for such services.

The new division represents an elevation of the Institute's National Center for Prevention and Control of Alcoholism to an organizational level where, with additional funds and staff, alcoholism treatment services and prevention programs can be expanded.

Other programs of the division—all directly or indirectly related to the establishment, ex-

pansion, or improvement of prevention and treatment programs—will emphasize several areas. These include (a) basic research on alcohol problems, (b) experimental or model programs of treatment, rehabilitation, and prevention, (c) training of professional and paraprofessional personnel as needed to participate in programs of treatment and prevention, and (d) coordination and liaison functions designed to help concentrate all pertinent Federal resources upon the problems of alcohol abuse and alcoholism. The Institute also is developing broad public education and information programs in alcohol abuse and alcoholism.

The new division will be responsible for assuring that what is already known in detection, treatment, rehabilitation, and prevention is effectively applied, and that newly acquired knowledge is used as quickly and as beneficially as possible. Emphasis will be placed on overcoming the barriers created by a shortage of trained skilled manpower.